

**CLAIM AMENDMENTS**

1. (Currently Amended) An improved additive manufacturing process, comprising the steps of: providing a computer-aided design (CAD) description of a part to be fabricated; providing a feedstock of material increments, each having a peripheral shape and a bonding

surface;

consolidating ~~material~~ the increments at a bond zone associated with their respective bonding surfaces in accordance with the CAD description to produce the part without melting the increments in bulk; and

performing the following steps, alone or in combination, to improve uniformity in fabrication:

maintaining consistent energy delivery to the bond zone;

maintaining consistent stiffness and mechanical resistance to vibration in the bond zone;

and

maintaining uniform thermal conditions in the bond zone.

2. (Original) The method of claim 1, wherein the step of maintaining consistent energy delivery to the bond zone includes the steps of:

determining the local geometry of the part being fabricated; and

using the local geometry to apply appropriate weld parameters.

3. (Original) The method of claim 2, including the step of specifying the local geometry in terms of current bond zone width, height of feature, or location with respect to initiation or termination of the bond zone.

4. (Original) The method of claim 3, wherein the appropriate weld parameters calculated in real time in accordance with the local geometry.

5. (Original) The method of claim 3, further including the use of a look-up table containing previously identified weld parameters.

6. (Original) The method of claim 3, further including the use of an adaptive control method to derive the level of energy required for a uniform weld at the bond zone.

7. (Original) The method of claim 6, wherein the adaptive control method is based upon a Kalman filter or pole placement.

8. (Original) The method of claim 6, wherein the adaptive control method is based upon artificial intelligence.

9. (Original) The method of claim 6, wherein the artificial intelligence technique is based on a rule-based system, fuzzy logic, neural network, or genetic algorithm.

10. (Original) The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes controlling applied force, the amplitude of the delivered energy, or welding speed.

11. (Original) The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes the use of initiation and termination process parameters during bonding.

12. (Original) The method of claim 11, wherein the initiation and termination process parameters are a function of the energy applied to the feature being built, the instantaneous aspect ratio of the part as it is built, the width of the feature, or the ratio of a feature dimension to feed dimension.

13. (Original) The method of claim 11, wherein the initiation and termination process parameters include force, speed, and/or ultrasonic wave amplitude.

14. (Original) The method of claim 11, wherein the initiation and termination process

parameters are used to compensate for variations in the solid mechanics of the component as its geometry changes.

15. (Original) The method of claim 11, wherein the initiation and termination process parameters are used to initiate the moving flowing plastic flow front at the interface between previously deposited material and the volume of material currently being applied.

16. (Original) The method of claim 1, further including the steps of:  
using a grid or other geometric map to identify the aspect ratio and/or volume of discrete features on the object;  
finding height-to-width ratio and/or total volume based upon the aspect ratio and/or volume of the discrete features; and  
assigning appropriate processing parameters as a function of height-to-width ratio and/or total volume.

17. (Original) The method of claim 16, wherein the processing parameters include speed, pressure and/or amplitude.

18. (Original) The method of claim 16, wherein the step of finding height-to-width ratio and/or total volume uses a look-up table.

19. (Original) The method of claim 16, further including the step of determining whether or not to incorporate a support or stiffening feature through the use of the grid or other geometric map.

20. (Original) The method of claim 1, further including the step of varying feedstock geometry to increase the degree of relative motion in the X-Z or Y-Z plane.

21. (Original) The method of claim 20, further including the step of using geometries which include an angle in the relevant directions.

22. (Original) The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes the use of a support feature which is conducive to easy removal during trimming and finishing of the part.

23. (Original) The method of claim 22, wherein the support feature is a stepped buttress.

24. (Original) The method of claim 22, wherein the support feature is continuous, intermittent, applied around corners, applied only at corners, on the periphery of an entire part, at the periphery of a specific feature on a larger part, or along an edge.

25. (Original) The method of claim 1, wherein the step of maintaining uniform thermal conditions in the bond zone includes controlling the temperature of the build/part being produced, the substrate, the feedstock or the fabrication environment.

26. (Original) The method of claim 22, wherein the bond zone is heated to a temperature near the temperature of the feedstock.

27. (Original) The method of claim 22, wherein the bond zone is heated to a temperature between 0.2 and 0.8 of the melting temperature of the feedstock material.

28. (Original) The method of claim 22, further including the step of controlling the local thermal history in the bond zone using process parameter control, supplementary thermal control, or a combination thereof.

29. (Original) The method of claim 22, wherein the temperature of the entire build is controlled to within a desired temperature range.

30. (Original) The method of claim 29, including the use of a heat source secured to a build

platform.

31. (Original) The method of claim 22, wherein the heat source is an electric base heater, IR heater, induction heater, radiative heater, strip heater, resistance heater, heat blanket, lasers, torch, or electronic heater.

32. (Original) The method of claim 22, wherein the heat source includes the use of air, hot water, hot oil, or steam.

33. (Original) The method of claim 22, wherein the heat is supplied through channels built into the growing object, etc.

34. (Original) The method of claim 22, wherein the heat source is controlled by a closed-loop process-parameter control system.

35. (Original) The method of claim 22, wherein the closed-loop process-parameter control system uses contacting or non-contacting temperature sensors.

36. (Original) The method of claim 22, including the use of local as opposed to general heating of the part.

37. (Original) The method of claim 36, wherein the local heating is provided by a laser, or other high intensity light source.

38. (Original) The method of claim 37, wherein the local heating source travel along with an ultrasonic sonotrode.

39. (Original) The method of claim 22, including the step of generating a consistent thermal profile by heating of the feedstock, a sonotrode or both.

40. (Original) The method of claim 22, including the use of an open- or closed-loop technique for ensuring that the temperature remains within a set range.

41. (Original) The method of claim 40, wherein the technique includes a sensor driven control system based upon adaptive feedback or artificial intelligence.

42. (Original) The method of claim 40, wherein the technique includes the use of an expert system, fuzzy logic or neural network.

43. (Original) The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes the use of secondary materials.